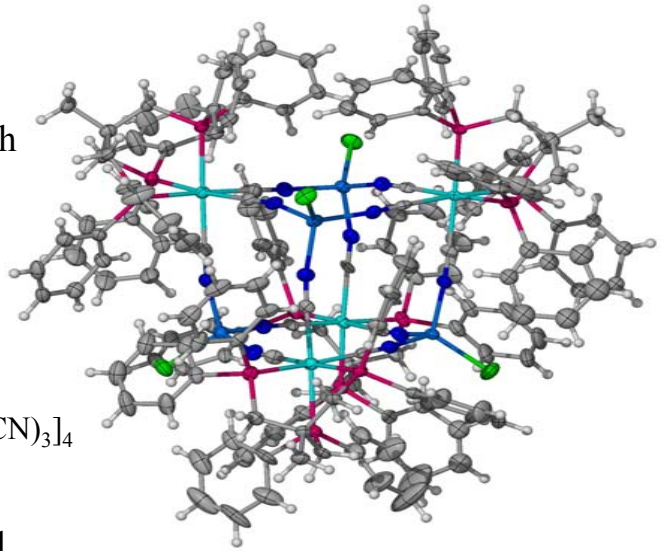
NIRT: Molecular Nanomagnets

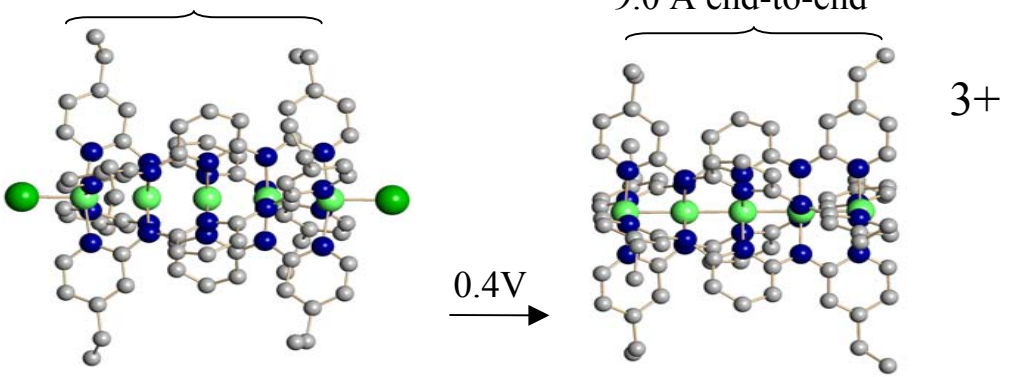
D.G. Naugle, G. Agnolet, F.A. Cotton, K.R. Dunbar, V. Pokrovsky, J.H. Ross, Jr.
Texas A&M University — DMR-0103455

Theory and experiment are being combined to design and create new single molecule nanomagnets and incorporate them into building blocks of thin films and composite materials. The trifouroacetate ligand has been fully substituted on the Mn_{12} family of single molecule magnets. Thin films of Mn_{12} acetate and flouroacetate have been grown by a novel method, Matrix Assisted Pulsed Laser Evaporation (MAPLE), and verified to be superior to those obtained by conventional means. In response to theoretical arguments for the need for nanomagnets with higher symmetry, two new magnetic molecules with octahedral symmetry based on Re_4M_4 (M=Fe, Co) clusters have been synthesized. Efforts to develop molecular wires have led to new trinickel and pentanickel molecules where metallic Ni-Ni bonding can be induced by an applied potential in solution. Beyond the fundamental science of nanomagnets, the project will continue to pursue nanoscience applications through manipulation and use of single molecules for application in high density magnetic storage and quantum computers.

Nanomagnets with octahedral symmetry



$[CoCl]_4[(triphos)Re(CN)_3]_4$



$Ni_5(etpda)_4Cl_2$ (no Ni–Ni bonds) $Ni_5(etpda)_4(PF_6)_3$ (Ni–Ni bonds)

Pentanickel wires wrapped with organic insulating ligands, an electrical and physical switch at a potential of 0.4 V

NIRT: Molecular Nanomagnets

D.G. Naugle, G. Agnolet, F.A. Cotton, K.R. Dunbar, V. Pokrovsky, J.H. Ross, Jr.
Texas A&M University — DMR 0103455

Outreach Activities:

•Eight week summer research program provided for high school teacher, 4 year college teacher and two undergraduate researchers.

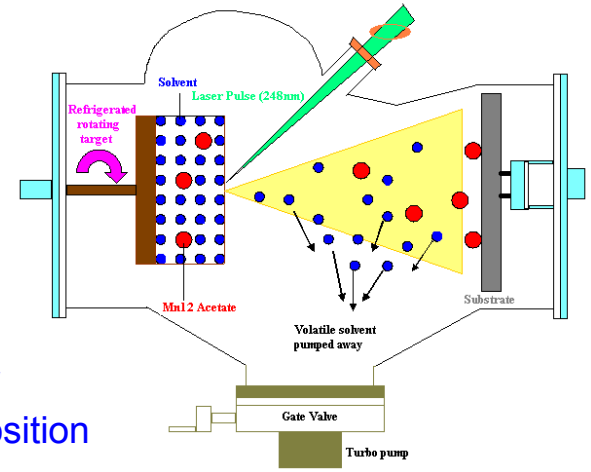
•New interdisciplinary graduate course for materials science and engineering majors developed and taught.

•Demonstrations of materials/solid state/low temperature physics phenomena presented in public lectures for high school students, university undergraduates and high school teachers.

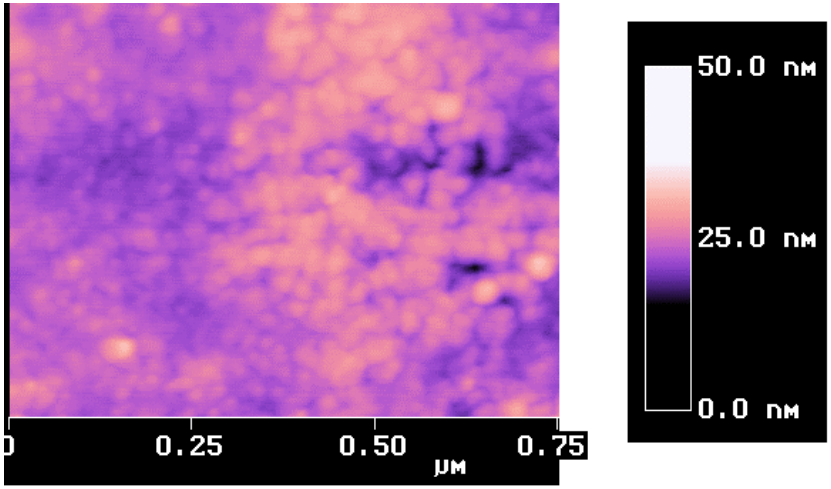
•Graduate and undergraduate students ran booth of hands on demonstrations for K-12 students and parents in conjunction with Stephen Hawking's lecture in Spring, 2003.

Education:

Undergraduate Students – 6
Graduate Students – 16
Postdoctoral Researchers – 5
In participating with this project they received training in a wide range of synthesis, characterization, measurement and calculation skills. Five students completed Ph.D's, five completed B.S. degrees (two with the Honors Thesis).



Schematic of MAPLE deposition system



Atomic Force Micrograph of Mn_{12} fluoroacetate film